EXPLORING NEWTON'S SECOND LAW

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KINEMATIC EQUATIONS REVIEW

$$V_f = V_i + at$$

$$\Delta x = V_i t + \frac{1}{2} a t^2$$

$$V_f^2 = V_i^2 + 2a\Delta x$$

$$\Delta x = \frac{1}{2}(V_i + V_f)\, t$$

NEWTON'S LAWS

1. An Object in motion will stay in motion and object at rest will stay at rest unless an external force is applied.
2. **Force=Mass x Acceleration**
3. For every action there is an equal and opposite reaction

These three laws of motion help us understand how everything in the world works. For today we will be focusing on the second law

WHAT DOES IT ALL MEAN?

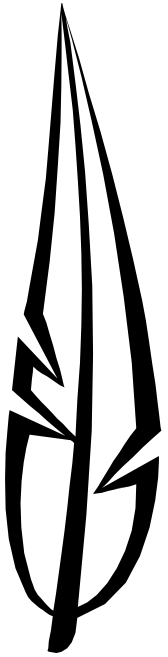
Force- Any external effort that causes an object to undergo a certain change(units: Newton)

Mass- How much of a substance there is (units: kilograms)

Acceleration- The rate at which velocity changes(units: m/s^2)

FORCE=MASS X ACCELERATION

- It is harder to pick up a brick than a piece of paper. Why?
  - A brick has more mass than paper
  - Requires more force to accelerate



EXAMPLE

Sallie has three passions in life: Skydiving, Physics, and her 10kg kitty, Kevin. In a desire to combine all three she built Kevin a parachute so he can go skydiving with her. When testing it out, she observed that after 5 seconds falling with the parachute, Kevin's velocity was 15 m/s. Using kinematic equations and your knowledge of Newton's laws, determine how much force was applied by the parachute.

SOLUTION

First, we need to find Kevin's acceleration using kinematic equations

$$V_f = V_i + at$$

Kevin's final velocity = 15 m/s

Kevin's initial velocity: 0 m/s

Time passed: 5 s

$$15 = 0 + 5a$$
$$a = 3\ m/s^2$$

DON'T FORGET YOUR UNITS!!!

SOLUTION (CONTINUED)

- Now we're going to use Newton's law to determine the net force on Kevin.

$$F = ma$$

Kevin's mass: 10 kg

Kevin's acceleration: 3 m/s

$$F = 10 * 3$$

Net force on Kevin: 30 N

What direction is that force?

BUT WAIT THERE'S MORE

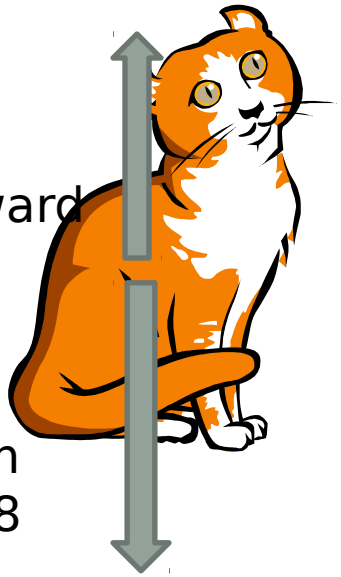
- We know the net force on Kevin is 30N, but the parachute is not the only thing applying force on him! What other forces do we have to take into account?

FORCE DUE TO GRAVITY

- Kevin weighs 10kg, and acceleration due to gravity is 9.8 m/s^2. How much force is gravity applying to him? And in what direction?

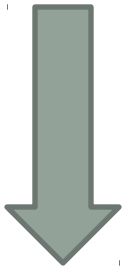
98 Newton, Downward

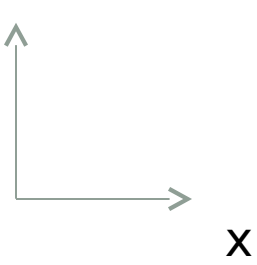
FREE BODY DIAGRAM



Force from parachute: Unknown upward

Force from gravity: 98 Newton downward (-98 N)





Net force: -30 Newton downwar

If we assume upwards is positive, the net force is -30 N and Force due to gravity is -98N

$$F_{net} = F_p - F_g$$

$$-30 = F_p - (-98)$$

$$F_p = 68N$$

NOW LET'S EXPLORE F=MA

- Pull out your worksheets and begin the activity!
- Here are the kinematic equations, you will need to use them!

$$V_f = V_i + at$$

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$$V_f^2 = V_i^2 + 2a\Delta x$$

$$\Delta x = \frac{1}{2}(V_i + V_f)\, t$$